Testing and Evaluation of a CNG Compressor Utilizing Advanced Rotary Design

Subcontractor

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Objective

To design, develop, and demonstrate an advanced rotary compressor (ARC)-based compressed natural gas (CNG) compression station for vehicle refueling applications. The goal of the ARC technology is to reduce the capital cost to manufacture and install a standardized 100-scfm CNG compression station.

System	Target (2-yr goal)	Target (5-yr goal) Station	Current Recip. Station	Current ARC
Cost/scfm (100 scfm @ 5 psi inlet)	$1200	$1000	$1900	$1600
Cost/scfm (200 scfm @ 25 psi inlet)	$600	$500	$800–$1000	$800

Figure 1: Compressor target costs

Approach

To determine the potential of ARC technology for reducing the capital cost of a CNG compressor station, we must first determine the current state of compressor technology and market characterization. Once we have done that, we will complete a detailed analytic and mechanical design. Based on that design, we will design and laboratory test a 100-scfm prototype compressor to meet the design objective of 3600 psi compression. We will also evaluate and test the compressor station auxiliaries to determine the design's overall effectiveness.

Accomplishments

A three-stage ARC compressor was designed and fabricated. Although component durability was a problem, Aurora Technology Corporation (Aurora) was able to demonstrate proof-of-concept for the first two stages of the compressor. Because of a variety of problems, such as third stage heat transfer, roller bearing material wear, and ineffective oil separation, the third stage did not meet the design requirements. Rochester Institute of Technology (RIT) performed a technical audit, and determined that setbacks in oil flow, bearing, and auxiliary performance were affecting the compressor's ability for sustained third stage compression, but there are no basic technological barriers to the ARC design.

The laboratory testing resulted in improvements to the ARC design by: (1) identifying compatible component materials, (2) identifying the necessary clearances, (3) increasing cooling capacity for all three stages, (4) increasing third stage oil flow, (5) respecifying bearing tolerances and materials, and (6) reducing the roller mass inertia.

Future Direction

Laboratory testing of the current three-stage ARC compressor will continue. For this design to work effectively, the bearing and auxiliary problems identified earlier need to be solved. Aurora will investigate the possibility of designing auxiliaries specifically for the ARC compressor. Aurora is also working with Amoco to find a solution to the oil foaming problem in the third stage. If these problems are adequately solved and the compressor can meet the criteria of sustained 3600 psi, a second phase on commercial development may take place.

Publication

None to date.

System (100 scfm @ 5 psi inlet)	**Reciprocating Station**	**Advanced Rotary Compressor**
Compressor	$30,000	$18,000
Compressor Auxiliaries	$67,369	$62,006
Station Auxiliaries	$90,697	$79,602
Total	$188,066	$159,986

Figure 2: Compressor station cost estimates